NxPCM Assessment for Latent Virus and Immune Function

Date Evaluated: March 23, 2009

Study Title: DSO 493: Incidence of Latent Virus Shedding During Spaceflight (Latent Virus)
Principal Investigators: Duane Pierson, Ph.D. (NASA/JSC); Satish Mehta, Ph.D. (EASI); Raymond Stowe, Ph.D. (Microgen Laboratories)

And

Study Title: DSO 498: Flight-Induced Changes in Immune Defenses (Immune Function)
Principal Investigators: Duane Pierson, Ph.D. (NASA/JSC); Satish Mehta, Ph.D. (EASI)

Research Gaps

- Gap(s) associated with this study:
  - IM1: Lack of in-flight immune data. In-flight data required to determine risk.
  - IM2: Formulation of an improved immunology standard for exploration spaceflight.
- Recommended future studies or gap(s):
  - Based on the data from these studies, the project suggests the need for future investigations. Additional ground based countermeasures studies need to be initiated focused on the suppression of viral reactivation and mitigation of the suppressed innate immune system seen in these studies. Data from the Integrated Immune flight study that is currently in progress will be vital to characterize the risks and persistence of immune dysregulation in-flight and determine the need for additional future studies.
  - The PIs also suggest the need for the evaluation of shelf-life/stability studies for antiviral drugs during space flight.
  - The project does not recommend any new gaps at this time. Once more data regarding the Integrated Immune flight study is available, a gap assessment will be performed and new gaps will be suggested if needed at that time.

***Study Summary (From PI submitted Final Report)**:*
DSO 493 Viral Reactivation and DSO 498 Immune Function were initiated in response to a FASEB directed report. Both DSOs conducted ground-breaking research not previously conducted on U S astronauts. DSO 493 demonstrated reactivation and shedding of herpes viruses in saliva and urine of astronauts for the first time. Not only did four of eight human herpes viruses tested reactivate, this study showed that the viruses were active and infectious when shed in saliva. The results of this DSO clearly showed that

viral reactivation was vastly increased in response to spaceflight. The results of DSO 493 established the presence of Varicella zoster virus (VZV) in saliva for the first time. Another first was the measurement of five neuropeptides in astronauts. For many years, viral reactivation was the major immune status indicator analyzed during the actual flight phase. The PCR-based assay for the viruses was transferred to physicians in the community and universities. The NASA-developed assay has proven to be a rapid test to be used in early diagnosis of shingles. New technology from this effort resulted in a patent application being filed in 2008. This technology is designed for doctors' offices and spaceflight to detect viral reactivation. Early diagnosis provided by this technology results in early intervention and reduced damage to the host. DSO 498 Immune Function also conducted studies on cells in the innate immunity arm for the first time. For example, functional studies evaluating the ability of neutrophils and monocytes to engulf and kill invading microorganisms were conducted as a focus of DSO 498. Similarly, the ability of NK-cells to attack and destroy target cells (their normal function) was completed on U S astronauts for the first time. All studies incorporated strong statistical analysis provided by the SD biostatistician. Major antimicrobial functions of neutrophils, monocytes, and NK-cells were decreased ~50%. In our studies, we found no effects attributed to gender, age, or flight experience of participating astronauts. Given the findings, these viral and immune studies must be repeated on longer ISS missions to determine if the findings in these studies are temporary or do the effects become greater with longer stays in space. The major accomplishments (products) of DSOs 493 and 498 are documented in 23 peer-reviewed manuscripts published in a variety of well-respected journals. Manuscripts cited in this report are archived with the Project and are available for the Element and Program as needed.